(54) **Interference suppression in RF signals**

Interferenzunterdrückung für HF-Signale

Suppression d'interférence pour signaux radio

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(56) References cited:
US-A- 4 811 425   **US-A- 5 179 730**
US-A- 5 212 826

EP 0 875 988 B1

Description

[0001] The present invention relates to a method and apparatus for suppressing interference in radio frequency (RF) signals. More particularly, the present invention relates to the suppression of interference in direct conversion RF receivers.

[0002] The majority of radio receivers utilise a superheterodyne type receiver which shifts the carrier frequency of a selected radio channel from an initial high frequency to a lower fixed intermediate frequency (IF) prior to demodulating the information signal. The superheterodyne receiver performs band-pass filtering at the IF frequency so that the bandwidth of the filter can be relatively small whilst still allowing for receipt of a large number of channels from which a desired channel can be chosen. The dynamic range of the superheterodyne receiver is therefore considerable.

[0003] An alternative to the superheterodyne receiver is the homodyne or direct conversion receiver which comprises a tunable local oscillator (LO) which is tuned to the carrier frequency of the radio signal to be received. The LO signal is mixed with the radio signal to directly down-convert the radio signal into a baseband signal. Due to the relative simplicity of the direct conversion receiver, there has long been interest in using such receivers in applications where cost and size are of critical importance. One such application is that of mobile communication devices. However, the limited dynamic range provided by direct conversion receivers has in practice restricted their use. The key factor responsible for this limitation is the spurious amplitude modulation (AM) and DC components generated by the mixer in the demodulated signal. As is illustrated in Figure 1, this interference arises from RF signals leaking from the RF input 1 of the mixer 2 to the local oscillator input 3 which in turn gives rise to even ordered products in the output 4 of the mixer 2. For example, with a signal sinx, leakage results in a product $(sinx)^2 = 1 + sin2x$ where the first term contributes a DC component.

[0004] In the case of digital data reception, the receiver decides upon whether or not a received digital data sample is a 0 or a 1 on the basis of the DC voltage level of the demodulated signal. Thus. any DC offset caused by RF signals coupling to the local oscillator input of the mixer (or LO signal leaking into the RF input) can result in the receiver making a wrong decision as to the state of the received signal. In direct conversion receivers, it is necessary to bandpass filter the input signal over a relatively narrow bandwidth in order to minimise cross-channel interference. The dynamic range of a direct conversion receiver (or the number of channels which it can receive) is therefore relatively small compared to that of a superheterodyne receiver.

[0005] A number of potential solutions to this problem have been proposed. These tend to rely upon the use of DC filters. However, when a narrow band filter is used, the settling time becomes long such that the filter cannot react to quick changes of power. On the other hand, with a wideband filter it is possible to achieve a short settling time but at cost of filtering out a substantial part of the wanted signal.

[0006] US5,212,826 describes a method of compensating a wanted signal for DC offset by blocking the received RF signal from entering the receiver during periods when the wanted signal is not transmitted. The DC offset during this period is measured and a resulting constant correction factor is calculated and fed into a correction circuit which processes the RF signal during the subsequent reception period. However, because the correction factor is constant over a continuous reception period, variations in the DC level during this period are not compensated for.

[0007] There is described in US5,179,730 a direct conversion receiver suitable for demodulating quadrature phase shift modulated (QPSM) signals. Conventional QPSM receivers split a received RF signal into two signal components. These components are applied to respective mixers, with the first mixer mixing the received signal with a LO signal which is 90° out of phase with the LO signal applied to the second mixer. US5,179,730 addresses the problem of mismatching occurring between the two mixers and the LO signals and which results in phase and amplitude errors in the demodulated baseband signals. US5,179,730 proposes providing a third mixer which mixes the input signal with a third LO signal which is out of phase with both of the LO signals applied to the first and second mixers. The outputs of the mixers are combined to produce a correction signal which is used to compensate phase and amplitude errors in the in-phase and quadrature phase signals. This document does not address the problem of spurious amplitude modulation (AM) and DC components generated at the mixer. Indeed, if such components are present, the efficiency of the mixer mismatch correction will be reduced.

[0008] According to a first aspect of the present invention there is provided a method of suppressing interference in a direct conversion RF receiver, the method comprising the steps of:

receiving an RF signal containing a wanted signal modulated onto at least one carrier signal at a carrier frequency;

splitting the RF signal into at least first, second and third RF signal components;

mixing said RF signal components with respective first, second and third local oscillator signals at said carrier frequency and phase shifted relative to one another, to produce first, second and third baseband signals containing first, second and third phase shifted wanted signal components respectively;

combining said baseband signals so as to substantially cancel the first, second and third phase shifted wanted signals and providing the residual signal as

a correction signal; and

combining the correction signal with at least one of the baseband signals to correct that signal for interference.

[0009] It will be appreciated that the present invention is particularly applicable to direct conversion RF receivers in which second order interference effects are generated in the RF mixer.

[0010] Preferably, said step of combining the baseband signals comprises scaling at least one of the baseband signals by a predetermined factor and summing the scaled baseband signal(s) with the other baseband signal(s). Said step of combining the correction signal with at least one of the baseband signals may comprise the step of scaling the correction signal.

[0011] Where the wanted signal comprises an in-phase signal component (I) and a quadrature phase signal component (Q) modulated onto respective phase shifted carrier signals having a common carrier frequency, the phase shift between said first and second local oscillator signals is preferably substantially 90 degrees so that said first and second baseband signals contain the demodulated in-phase and quadrature phase signal components respectively. Preferably, the third local oscillator signal is offset by 135 ° from both the first and second local oscillator signals in which case the first, second and third baseband signals are scaled in the ratio 1:1: $\sqrt{2}$ prior to summing. However, it will be appreciated that other phase shifts may be used and the scaling ratio determined accordingly.

[0012] Preferably, the correction signal is subtracted from both the first and second baseband signals in order to correct these signals for interference. The results of the subtractions in the case of in-phase/quadrature phase modulation are an in-phase wanted signal component and a quadrature phase wanted signal component.

[0013] The RF signal may be split into four or more RF signal components, each component being mixed with a phase shifted local oscillator signal to produce respective baseband signals each of which contains a phase shifted wanted signal. A correction signal is generated by scaling and summing the baseband signals, in accordance with the relative phase shifts, to cancel the wanted signal components.

[0014] According to a second aspect of the present invention there is provided a direct conversion RF receiver comprising:

input means for receiving an RF signal containing a wanted signal modulated onto at least one carrier signal at a carrier frequency;

splitting means coupled to the input means for splitting the received RF signal into at least first, second and third RF signal components;

first, second and third mixing means coupled to the splitting means for receiving respective RF signal

components and for mixing the received RF components with respective local oscillator signals at said carrier frequency and phase shifted relative to one another, to produce first, second and third baseband signals containing first, second and third phase shifted wanted signal components respectively;

first combining means coupled to the mixing means for combining said baseband signals so as to substantially cancel the phase shifted wanted signal components and for providing the residual signal as a correction signal; and

second combining means coupled to said first combining means and to at least one of the mixing means for subtracting the correction signal from at least one of the baseband signals to correct that signal for interference.

[0015] Preferably, said first combining means comprises scaling means for scaling at least one of the baseband signals by a predetermined scaling factor and summing means, e.g. a summing amplifier, for summing the scaled baseband signal(s) and the other baseband signal(s). Said second combining means may also comprise scaling means for scaling the correction signal.

[0016] Preferably, all of said mixing means are provided on a common semiconductor wafer so as to minimise differences in the operational performance of the mixers.

[0017] Preferably, the receiver comprises a local oscillator for generating said local oscillator signals and phase shifting means for producing the relative phase shifts between said local oscillator signals.

[0018] According to third aspect of the present invention there is provided a mobile communication device comprising a direct conversion RF receiver according to the above second aspect of the present invention.

[0019] For a better understanding of the present invention and in order to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 shows schematically a mixer with RF signal leakage from an RF input to a local oscillator input;

Figure 2 shows schematically a direct conversion RF receiver embodying the present invention; and

Figure 3 shows a phasor diagram of the baseband signals generated by mixers of the direct conversion RF receiver of Figure 2.

[0020] As has already been described with reference to Figure 1, in a direct conversion receiver, it is often the case that a small amount of RF signal leaks from the RF input 1 of the mixer 2 to the local oscillator input 3 resulting in DC and slowly varying AM interference components in the mixed or baseband signal at the output 4 of the mixer 2. DC and slowly varying AM interference

components also arise from the non-ideal properties of the mixer 2. There is illustrated in Figure 2 a direct conversion RF receiver which allows these interference component to be substantially suppressed. It will be appreciated that the receiver will typically comprise a number of other components, e.g. amplifiers and filters, but these are not shown in Figure 2 for reasons of simplification.

[0021] An RF signal is detected at an RF antenna 5. The RF signal comprises a multiplicity of signal components, one of which is an in-phase/quadrature modulated signal (the 'wanted' signal) at a carrier frequency f_c. The detected RF signal is in turn applied to an input 6 of a splitter 7 which splits the RF signal into three equal and in-phase RF signal components. These components are applied to the inputs of respective first, second, and third mixers 8a,8b, and 8c.

[0022] A local oscillator 9 generates a local oscillator signal having a constant frequency equal to the carrier frequency f_c of the wanted signal. The local oscillator signal is split into first, second and third identical local oscillator signal components. Each local oscillator signal component is phase shifted by a predetermined amount by a respective phase shifting circuit 10a,10b, and 10c. The first local oscillator signal component is shifted by +45 ° relative to the generated local oscillator signal, the second local oscillator signal is shifted by -45 °, and the third local oscillator signal is shifted by 180 °. The local oscillator signal components are applied to respective mixers 8a,8b, and 8c.

[0023] The three mixers 8a.8b, and 8c produce at their respective outputs first, second, and third baseband signals. The first baseband signal comprises the downconverted wanted signal shifted by 45 ° plus interference generated by coupling between the inputs to the associated mixer 8a. In fact, this downconverted and phase shifted signal is the demodulated quadrature phase component I. Similarly, the second baseband signal comprises the downconverted wanted signal shifted by -45° (the in-phase component Q) plus the interference, whilst the third baseband signal comprises the downconverted wanted signal shifted by 180 ° (a 'reference' component R) plus the interference.

[0024] Figure 3 illustrates the three downconverted wanted signal components I,Q and R contained within the baseband signals. It will be appreciated that if the third baseband signal is multiplied by a factor of $\sqrt{2}$, and the resulting scaled signal is summed with the first and second baseband signals, the wanted signal components I,Q and R in the three baseband signals will cancel out. Assuming that the three mixers 8a,8b, and 8c are substantially identical, a similar degree of cross-coupling between the respective inputs will occur and the baseband signals will each contain a substantially identical interference signal. Whilst the summing of the baseband signals will substantially cancel the wanted signal components, the interference components I will be superimposed on one another, i.e. the summed sig-

nal will contain an interference signal equal $(2+\sqrt{2})I$.

[0025] The output of the third mixer 8c is provided to an input of a summing amplifier 11 via a multiplier 12 which multiplies the mixer output by a factor of $\sqrt{2}$. The outputs of the first and second mixers 8b,8c are provided directly to respective summing amplifier inputs. The output of the summing amplifier 11 is provided to a divider 12 which divides the amplifier output by $(2+\sqrt{2})$ and provides a correction signal which is combined with the first and second baseband signals at first and second comparators 13a,13b. The comparators 13a,13b provide at their outputs corrected in-phase and quadrature phase components of the wanted signal.

[0026] In order to ensure that each of the baseband signals comprises a substantially identical interference component, the mixers 8a,8b, and 8c are as closely matched as possible. This typically involves fabricating the mixers on a common semiconductor wafer. The summing amplifier 11, divider 12, comparators 13a,13b, and other receiver components, can also be fabricated on the same wafer to provide a completely integrated direct conversion receiver.

[0027] It will be appreciated that modifications may be made to the above described embodiment without departing from the scope of the invention. For example, the relative phase shifts between the first, second and third local oscillator signal components may be any appropriate value, e.g. a constant 120 degrees or 0, 90, and 180 degrees.

[0028] Mismatching between the mixers may be compensated for, to some extent, by splitting the RF signal into four or more components and by mixing these components with respective phase shifted LO signals. The resulting baseband signals can then be scaled and summed to provide a single correction signal. However, this increases the complexity and power consumption of the receiver.

Claims

1. A method of suppressing interference in a direct conversion RF receiver, the method comprising the steps of:

    receiving an RF signal (5) containing a wanted signal modulated onto at least one carrier signal at a carrier frequency;
    splitting the RF signal (7) into at least first, second and third RF signal components;
    mixing said RF signal components (8a, 8b, 8c) with respective first (10a), second (10b) and third (10c) local oscillator signals at said carrier frequency and phase shifted relative to one another, to produce first, second and third baseband signals containing first, second and third phase shifted wanted signal components respectively;

combining (11) said baseband signals so as to substantially cancel the first, second and third phase shifted wanted signals and providing the residual signal as a correction signal; and combining the correction signal (13a, 13b) with at least one of the baseband signals to correct that signal for interference.

2. A method according to claim 1, wherein the wanted signal comprises an in-phase signal component and a quadrature phase signal component, the phase shift between said first and second local oscillator signals (10a, 10b) being substantially 90 degrees so that said first and second baseband signals contain the demodulated in-phase and quadrature phase signal components respectively.

3. A method according to claim 2, wherein the third local oscillator signal (9) is offset by substantially 135° from both the first and second local oscillator signals and the first, second and third mixed signals are scaled in the approximate ratio $1:1:\sqrt{2}$ prior to summing and the correction signal is divided by approximately $(2+\sqrt{2})$ prior to combining the signal with said at least one baseband signal.

4. A method according to any one of the preceding claims, wherein the correction signal (13a, 13b) is scaled and subtracted from both the first and second baseband signals in order to correct these signals for interference.

5. A method according to any one of the preceding claims and comprising splitting the RF signal (5) into four or more RF signal components and mixing each additional component with a local oscillator signal phase shifted relative to the other local oscillator signals, the first combining step comprising combining all of the resulting baseband signals to substantially cancel the wanted signal components to provide said correction signal.

6. A direct conversion RF receiver comprising:

input means (5,6) for receiving an RF signal containing a wanted signal modulated onto at least one carrier signal at a carrier frequency; splitting means (7) coupled to the input means for splitting the received RF signal into first, second and third RF signal components; first, second and third mixing means (8) coupled to the splitting means (7) for receiving respective RF signal components and for mixing the received RF components with respective local oscillator signals at said carrier frequency and phase shifted relative to one another, to produce first, second and third baseband signals containing first, second and third phase

shifted wanted signal components respectively;

first combining means (11,12) coupled to the mixing means (8) for combining said baseband signals so as to substantially cancel the phase shifted wanted signal components and for providing the residual signal as a correction signal; and

second combining means (13) coupled to said first combining means (11,12) and to at least one of the mixing means (8) for subtracting the correction signal from at least one of the baseband signals to correct that signal for interference.

7. A receiver according to claim 6, wherein all of the mixing means (8) are provided on a common semiconductor wafer so as to minimise differences in the operational performance of the mixers.

8. A receiver according to claim 7 and comprising a local oscillator (9) for generating said local oscillator signals and phase shifting means (10) for producing the relative phase shifts between said local oscillator signals, said local oscillator (9) and said phase shifting means (10) being provided on said common wafer.

9. A mobile communication device comprising a direct conversion RF receiver according to any one of claims 6 to 8.

Patentansprüche

1. Verfahren zum Unterdrücken von Störungen in einem Direktumsetzungs-HF-Empfänger, das die folgenden Schritte umfasst:

Empfangen eines HF-Signals (5), das ein gewünschtes Signal enthält, das auf wenigstens ein Trägersignal mit einer Trägerfrequenz moduliert ist;
Unterteilen des HF-Signals (7) wenigstens in eine erste, eine zweite und eine dritte HF-Signalkomponente;
Mischen der HF-Signalkomponenten (8a, 8b, 8c) mit einem ersten (10a), einem zweiten (10b) bzw. einem dritten (10c) Hilfsoszillatorsignal mit der Trägerfrequenz, die relativ zueinander phasenverschoben sind, um ein erstes, ein zweites bzw. ein drittes Grundbandsignal zu erzeugen, die eine erste, eine zweite bzw. eine dritte phasenverschobene gewünschte Signalkomponente enthalten;
Kombinieren (11) der Grundbandsignale, um das erste, das zweite bzw. das dritte phasenverschobene gewünschte Signal im Wesentli-

chen aufzuheben und um das Restsignal als
ein Korrektursignal bereitzustellen; und
Kombinieren des Korrektursignals (13a, 13b)
mit wenigstens einem der Grundbandsignale,
um die Störung dieses Signals zu korrigieren.

2. Verfahren nach Anspruch 1, bei dem das gewünschte Signal eine Inphase-Signalkomponente und eine Quadraturphase-Signalkomponente umfasst, wobei die Phasenverschiebung zwischen dem ersten und dem zweiten Hilfsoszillatorsignal (10a, 10b) im Wesentlichen 90 Grad beträgt, so dass das erste und das zweite Grundbandsignal die demodulierte Inphase-Signalkomponente bzw. die Quadraturphase-Signalkomponente enthalten.

3. Verfahren nach Anspruch 2, bei dem das dritte Hilfsoszillatorsignal (9) gegenüber dem ersten und dem zweiten Hilfsoszillatorsignal um im Wesentlichen 135° versetzt ist und das erste, das zweite und das dritte gemischte Signal vor der Summation in einem ungefähren Verhältnis von $1:1:2^{1/2}$ skaliert werden und das Korrektursignal ungefähr durch ($2 + 2^{1/2}$) geteilt wird, bevor das Signal mit dem wenigstens einen Grundbandsignal kombiniert wird.

4. Verfahren nach einem der vorhergehenden Ansprüche, bei dem das Korrektursignal (13a, 13b) skaliert und sowohl vom ersten als auch vom zweiten Grundbandsignal subtrahiert wird, um die Störung dieser Signale zu korrigieren.

5. Verfahren nach einem der vorhergehenden Ansprüche, das das Teilen des HF-Signals (5) in vier oder mehr HF-Signalkomponenten und das Mischen jeder weiteren Komponente mit einem Hilfsoszillatorsignal, das zu den anderen Hilfsoszillatorsignalen phasenverschoben ist, umfasst, wobei der erste Kombinationsschritt das Kombinieren aller resultierender Grundbandsignale umfasst, um die gewünschten Signalkomponenten im Wesentlichen aufzuheben, um das Korrektursignal bereitzustellen.

6. Direktumsetzungs-HF-Empfänger, mit:

Eingangsmitteln (5, 6), die ein HF-Signal empfangen, das das gewünschte Signal enthält, das auf wenigstens ein Trägersignal mit einer Trägerfrequenz moduliert ist;
Unterteilungsmitteln (7), die mit den Eingangsmitteln gekoppelt sind, um das empfangene HF-Signal in eine erste, eine zweite und eine dritte HF-Signalkomponente zu unterteilen;
ersten, zweiten und dritten Mischermitteln (8), die mit den Unterteilungsmitteln (7) gekoppelt sind, die entsprechenden HF-Signalkomponenten empfangen und die empfangenen HF-Kom-

ponenten mit jeweiligen Hilfsoszillatorsignalen mit der Trägerfrequenz, die relativ zueinander phasenverschoben sind, mischen, um ein erstes, ein zweites bzw. ein drittes Grundbandsignal zu erzeugen, die eine erste, eine zweite bzw. eine dritte phasenverschobene erwünschte Signalkomponente enthalten;
ersten Kombinationsmitteln (11, 12), die mit den Mischermitteln (8) gekoppelt sind, um die Grundbandsignale zu kombinieren, um die phasenverschobenen erwünschten Signalkomponenten im Wesentlichen aufzuheben und das Restsignal als ein Korrektursignal bereitzustellen; und
zweiten Kombinationsmitteln (13), die mit den ersten Kombinationsmitteln (11, 12) und mit wenigstens einem der Mischermittel (8) gekoppelt sind, um das Korrektursignal von wenigstens einem der Grundbandsignale zu subtrahieren, um die Störung des Signals zu korrigieren.

7. Empfänger nach Anspruch 6, bei dem alle Mischermittel (8) auf einem gemeinsamen Halbleiterwafer vorgesehen sind, um Unterschiede des Betriebsverhaltens der Mischer minimal zu machen.

8. Empfänger nach Anspruch 7, der einen Hilfsoszillator (9) für die Erzeugung der Hilfsoszillatorsignale und Phasenverschiebungsmittel (10) für die Erzeugung der relativen Phasenverschiebungen zwischen den Hilfsoszillatorsignalen umfasst, wobei der Hilfsoszillator (9) und die Phasenverschiebungsmittel (10) auf dem gemeinsamen Wafer vorgesehen sind.

9. Mobilkommunikationsvorrichtung, die einen Direktumsetzungs-HF-Empfänger nach einem der Ansprüche 6 bis 8 umfasst.

Revendications

1. Procédé de suppression de l'interférence dans un récepteur radio à conversion directe, lequel procédé comprend les étapes consistant à :

recevoir un signal radio (5) contenant un signal voulu modulé sur au moins un signal modulé à une fréquence porteuse ;

diviser le signal radio (7) en au moins une première, une seconde et une troisième composante de signal radio ;

mélanger lesdites composantes de signal radio (8a, 8b, 8c) avec le premier (10a), second (10b) et troisième (10c) signal d'oscillateur local res-

pectif à ladite fréquence porteuse et en déca-
lage de phase l'un par rapport à l'autre, afin de
produire un premier, un second et un troisième
signal de bande de base contenant une premiè-
re, une seconde et une troisième composante
de signal voulu à phase décalée
respectivement ;.

combiner lesdits signaux de bande de base
(11) de manière à annuler substantiellement le
premier, second et troisième signal voulu à
phase décalée et délivrer le signal résiduel
comme signal de correction ; et

combiner le signal de correction (13a,13b) avec
au moins un des signaux de bande de base afin
de corriger ce signal pour l'interférence.

2. Procédé selon la revendication 1, dans lequel le si-
gnal voulu comprend une composante de signal en
phase et une composante de signal à quadrature
de phase, le décalage de phase entre lesdits pre-
mier et second signaux d'oscillateur local (10a, 10b)
étant substantiellement de 90° de telle sorte que
lesdits premier et second signaux de bande de base
contiennent les composantes de signal démodu-
lées en phase et à quadrature de phase respecti-
vement.

3. Procédé selon la revendication 2, dans lequel le
troisième signal d'oscillateur local (9) est décalé
substantiellement de 135° par rapport au premier
et au second signal d'oscillateur local et les premier,
second et troisième signaux mélangés sont éten-
dus dans le rapport approximatif 1 :1 :√2 préalable-
ment à la sommation et le signal de correction est
divisé d'approximativement (2+√2) préalablement à
la combinaison du signal avec au moins un signal
de bande de base.

4. Procédé selon l'une quelconque des revendications
précédentes, dans lequel le signal de correction
(13a,13b) est étendu et soustrait d'à la fois le pre-
mier et le second signal de bande de base afin de
corriger ces signaux pour l'interférence.

5. Procédé selon l'une quelconque des revendications
précédentes et consistant à diviser le signal radio
(5) en quatre ou plus composantes de signal radio
et à mélanger chaque composante additionnelle
avec un signal d'oscillateur local en décalage de
phase par rapport aux autres signaux d'oscillateur
local, la première étape de combinaison consistant
à combiner tous les signaux de bande de base ré-
sultants afin d'annuler substantiellement les com-
posantes du signal voulu pour fournir ledit signal de
correction.

6. Récepteur radio à conversion directe comprenant :

un moyen d'entrée (5,6) pour recevoir un signal
radio contenant un signal voulu modulé sur au
moins un signal modulé à une fréquence
porteuse ;

un moyen de division (7) couplé au moyen d'en-
trée pour diviser le signal radio reçu en une pre-
mière, seconde et troisième composante de si-
gnal radio ;

un premier, second et troisième moyen de mé-
lange (8) couplé au moyen de division (7) pour
recevoir les composantes de signal radio res-
pectives et pour mélanger les composantes de
signal radio reçues avec les signaux d'oscilla-
teur local respectifs à ladite fréquence porteuse
et en décalage de phase l'un par rapport à
l'autre, afin de produire un premier, second et
troisième signal de bande de base contenant
une première, seconde et troisième composan-
te de signal voulu à phase décalée
respectivement ;

un premier moyen de combinaison (11,12) cou-
plé au moyen de mélange (8) pour combiner
lesdits signaux de bande de base de manière
à annuler substantiellement les composantes
de signal voulu à phase décalée et pour délivrer
le signal résiduel comme un signal de
correction ; et

un second moyen de combinaison (13) couplé
audit premier moyen de combinaison (11,12) et
à au moins un des moyens de mélange (8) pour
soustraire le signal de correction d'au moins un
des signaux de bande de base afin de corriger
ce signal pour l'interférence.

7. Récepteur selon la revendication 6, dans lequel
tous les moyens de mélange (8) sont disposés sur
une tranche semiconductrice commune de manière
à minimiser les différences de performance opéra-
tionnelles des mélangeurs.

8. Récepteur selon la revendication 7 et comprenant
un oscillateur local (9) pour générer lesdits signaux
d'oscillateur local et un moyen de décalage de pha-
se (10) pour produire les décalages de phase rela-
tifs entre lesdits signaux d'oscillateur local, ledit os-
cillateur local (9) et ledit moyen de décalage de pha-
se (10) étant disposés sur ladite tranche commune.

9. Dispositif de communication mobile comprenant un
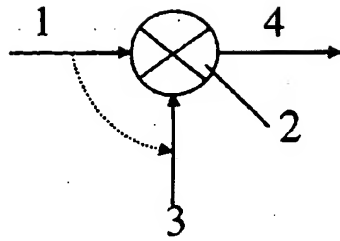récepteur radio à conversion directe selon l'une
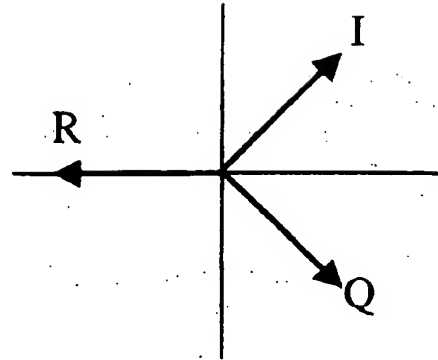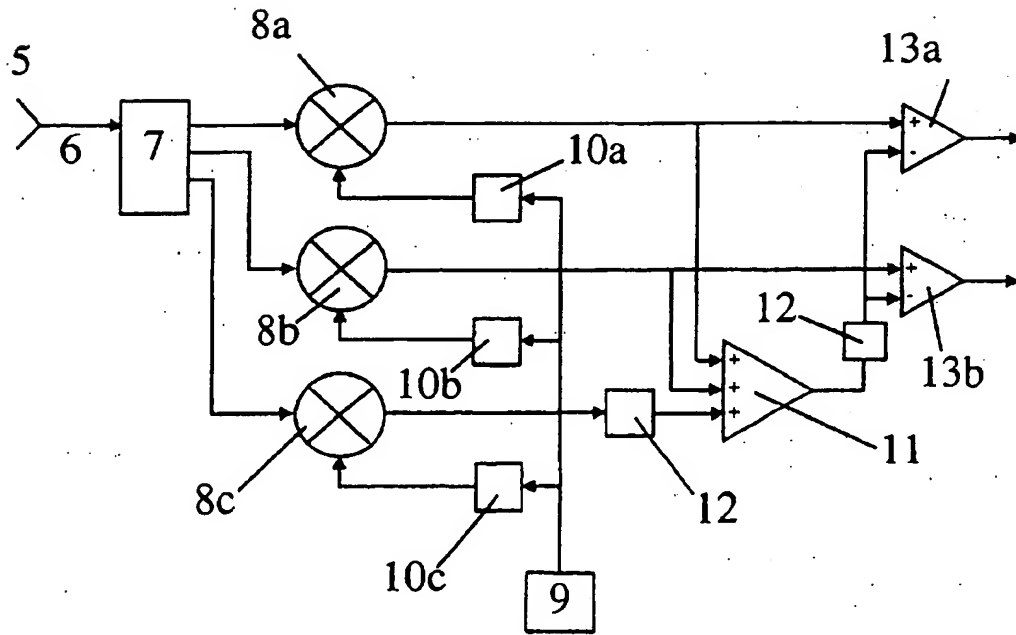quelconque des revendications 6 à 8.

Figure 1

Figure 3

Figure 2